NON-PUBLIC?: N
ACCESSION #: 8711090012
LICENSEE EVENT REPORT (LER)

FACILITY NAME: McGuire Nuclear Station, Unit 1 PAGE: 1 of 9

DOCKET NUMBER: 05000369

TITLE: Unit 1 Blackout While Testing Lockout Relays And Unit 2 Reactor Trip Due To Loss Of Instrument Air - Root Cause Was Personal Error
EVENT DATE: 09/16/87 LER #: 87-021-00 REPORT DATE: 10/29/87

OTHER FACILITIES INVOLVED:
FACILITY NAME: McGuire, Unit 2 DOCKET #: 05000370

OPERATING MODE: 6 POWER LEVEL: 000

THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR SECTION
50.73(a)(2)(iv)

LICENSEE CONTACT FOR THIS LER:
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SUPPLEMENTAL REPORT EXPECTED: No

ABSTRACT: On September 16, 1987, Instrument and Electrical (IAE) and Relay personnel were performing a test to verify operation of lockout relays and lights on which wiring modifications had been performed. At 1016, while a lockout relay and its associated lights were being tested, 2 associated relays energized causing the 1B Busline breakers to trip resulting in a Unit 1 blackout. The blackout caused a loss of power to Instrument Air (VI) Compressors which resulted in the closure of the Unit 2 Main Feedwater Regulator Valves. Unit 2 subsequently tripped on low-low Steam Generator level at 1021. Operations restored normal power to Unit 1 by energizing the 1B Busline and stabilized Unit 2 from the Reactor Trip by 1045. The cause of the event was personnel error. Planned corrective actions involving evaluation of VI compressor alignments, communicating importance of using and not exceeding procedures, and a design review of the power supply alignments for VI Compressors have been initiated.

(End of Abstract)

INTRODUCTION:

On September 16, 1987 Instrumentation and Electrical personnel and Relay personnel were performing a test to verify proper operation of lockout relays and associated indicating lights on which wiring modifications had been performed in accordance with a Nuclear Station Modification. At approximately 1016, while a lockout relay and its indicating light were being tested, two associated relays energized which caused 1B Busline breakers to trip. This trip resulted in a loss of essential power (Blackout) to Unit 1. The Blackout caused a loss of power to Instrument Air Compressors A, C, and D. This loss of Instrument Air resulted in the closure of the Unit 2 air operated Main Feedwater Regulating Valves. Unit 2 subsequently experienced a Reactor Trip due to a low-low Steam Generator C level signal at 1021:37. Operations implemented the procedures for the Unit 1 Blackout and the Unit 2 Reactor Trip. Operations personnel restored normal power to Unit 1 through 1B Busline by 1022 and realigned and restarted the tripped Instrument Air compressors. Unit 2 stabilized from the Reactor Trip at 1045.

Unit 1 was in Mode 6, Refueling, and Unit 2 was in Mode 1, Power Operation, at 100% power at the time of this event.

This event has been classified as Personnel Error due to Relay personnel not thoroughly tracing the applicable McGuire Electrical Elementary Drawings before doing additional relay checkout. Contributing to this event is the fact that Instrumentation and Electrical and Relay personnel tested beyond the directions of the procedure.

EVALUATION

Background

The Unit 1 6900V Auxiliary Power system (EIIS:EA) distributes power to the Unit 1 Normal Auxiliary Power system and serves as the preferred power supply to the Unit 1 Essential Auxiliary Power system. The Unit 1 6900V Auxiliary Power system consists of four independent switchgear (EIIS:SWGR) assemblies designated as 1TA, 1TB, 1TC and 1TD. The normal power supply to switchgear 1TA and switchgear 1TC is the Unit 1 Main Auxiliary Transformer (EIIS:XFMR) 1ATA (1A Busline) with the alternate supply being Unit 1 Main Auxiliary Transformer 1ATB (1B Busline). The normal power supply to switchgear 1TB and switchgear 1TD is 1B Busline (EIIS:BU) with the alternate supply being 1A Busline. Main Auxiliary Transformers 1ATA and 1ATB are sized to carry the loads of all 4 switchgear assemblies at the same time when transformer 1ATA or transformer 1ATB is out of service.

The 600V (EIIS:EC) Shared Motor Control Centers (SMXs) (EIIS:MCC) provide a centralized power source to shared station loads. The 600V Shared Motor Control Centers are supplied with power from the 600V Shared Load Centers

(SLXs) which are in turn powered by the 6900V Auxiliary Power System through 6900/600V transformers. Instrument Air (VI) (EIIS:LD) Compressors (EIIS:CMP) A, B, and C are powered from SMXT, SMXY, and SMXU, respectively. SMXT, SMXY, and SMXU receive normal power from switchgear 1TA, 2TD (Unit 2), and 1TA, respectively. Alternate power for SMXT, SMXY, and SMXU is from switchgear 2TD, 1TB, and 2TA

(Unit 2), respectively. Upon the loss of the normal source load center, the motor control centers will automatically fast transfer to the alternate source load center. VI Compressor D is supplied power from 1TB with no alternate source.

Each of the 6900V auxiliary switchgear assemblies has protective relaying associated with each incoming (normal and standby) breaker (EIIS:VACB). Protective relaying is used to detect power system faults and to initiate the tripping of the circuit breakers (EIIS:VACB) necessary to isolate the faulted section from the rest of the system. Relays designed as 186 series are lockout relays. A lockout relay is an auxiliary relay with no fault detecting ability of its own. It must be initiated by some protective relay or monitoring device and when initiated it performs a designated function.

The VI system supplies dry, oil free, compressed air to all instrumentation, diaphragm valves, piston operated valves, and other equipment requiring air for operability on both units. Air is compressed by 3 reciprocating air compressors (A, B, and C) and 1 centrifugal air compressor (D) and then held in 3 air receivers. VI Compressors A, B, and C have 3 modes of operation: Base, Standby 1, Standby 2, or off. VI Compressor D is either running (Base) or is off. The Base and Standby 1 compressors run continuously regardless of system pressure while the Standby 2 compressor remains off until a low-low air receiver (EIIS:RCV) pressure setpoint is reached. When placing a compressor in Base or Standby 1 mode, the start pushbutton must also be depressed. Compressor status at any given time is determined by the compressor mode of operation and air receiver pressure. As pressure falls, the Base compressor will modulate as necessary to maintain pressure. Should pressure continue to fall, the Standby 1 compressor will load first to 50% capacity and then to 100%. Should demand for compressed air continue, compressors in the Standby 2 mode will start and load. Normally, compressor D will be the Base compressor with compressors A, B, and C in Standby 1 or Standby 2 mode. The VI compressors can be controlled only from local control panels.

Description of Event

On the morning of September 16, 1987, Instrumentation and Electrical personnel (IAE) and Relay personnel began performing Temporary Test Procedure, Functional Verification of the "Lockout" Relays and Associated Indicating Lights. This procedure verified proper operation of lockout relays and associated lights on which wiring modifications had been performed according to a Nuclear Station Modification (NSM). IAE Supervisory personnel had previously questioned Relay personnel about performing additional testing of the lockout relays and lights by energizing additional relays which were not specified in the Lockout Relay Temporary Test procedure. IAE personnel wanted to ensure that all circuits which could affect lockout relay actuations were thoroughly checked. Relay personnel agreed that these additional checkouts could be performed and that Relay personnel would perform them.

At 1015, during the additional checkout of relay 186BB, relays 186A1B and 186B1B energized which tripped 1B Busline breakers. The 1B busline trip

resulted in a Unit 1 Blackout because 1A busline was already de-energized. Diesel Generator (EIIS:D/G) 1B automatically started and loaded on the Blackout signal. The Unit 1 Blackout caused a loss of the Unit 1 Residual Heat Removal (ND) system. Operations personnel responded quickly to implement Abnormal Procedures, Loss of Electrical Power and Loss of ND System. ND pump 1B was started and then automatically took power from the Diesel Generator (EIIS:DG) powered emergency bus.

VI Compressors A, C, and D were powered from Unit 1 and also lost power. VI system header pressure dropped quickly, causing the air operated Main Feedwater (CF) (EIIS:SJ) Regulating Valves (EIIS:FCV) to fail closed on Unit 2. Steam Generator (S/G) (EIIS:SG) levels then decreased, and at 1021:37, Unit 2 experienced a Reactor Trip due to S/G C low-low level. Operations personnel implemented Abnormal Procedure, Reactor Trip.

At approximately 1021, Operations personnel had restored power to Unit 1 through the 1B Busline and returned the Unit 1 ND system (EIIS:BP) and VI compressors to normal service. At 1045, Unit 2 has stabilized from the Reactor (EIIS:RCT) Trip. Operations personnel notified the NRC of the Unit 2 Reactor Trip and made notification of an Unusual Event on Unit 1 at 1200. The Unusual Event was terminated at 1400.

Conclusion

The Blackout on Unit 1 was the result of relays 186A1B and 186B1B energizing and tripping the 1B Busline breakers, which supplied the only source of offsite power for Unit 1. The procedure used to test the lockout relays (specifically lockout relay 186BB) allows only for a jumper to be placed

across two terminals to ensure that relay 186BB energizes and its associated light illuminates. The procedure also states that the busline associated with the relays to be tested must be de-energized. However, IAE personnel wanted to test beyond the requirements of the procedure to ensure that no circuits had been inadvertently altered during the modification. These additional checks included energizing other relays which, in turn, energize a lockout relay. IAE personnel requested Relay personnel to perform these checks since Relay personnel were the most knowledgeable in that area. These additional checks were performed by Relay personnel using only the McGuire Electrical Elementary Drawings (MCEEs) as a guide. Relay person "A" stated that he did not thoroughly check the MCEEs before energizing these additional relays. Had the 1B Busline been de-energized prior to the test, relays 186A1B and 186B1B would still have energized, but no Blackout would have occurred because the 1B Busline breakers would have already been open.

This report has been assigned a classification of Personnel Error due to Relay person "A" not thoroughly tracing the applicable MCEEs before doing additional checks for relay 186BB. Contributing to this event is the fact that IAE and Relay personnel tested beyond the directions of the procedure. Relay 186BB is a relay associated with 1B Busline, and according to the procedure, 1B Busline should have been de-energized to test that relay. Also, IAE and Relay personnel had no procedure with instructions for the additional checks. They

relied on the expertise of Relay personnel to do these checks. As reported in Licensee Event Report (LER) 369/87-20, a philosophy exists among some station personnel that procedures for non-safety related systems or components do not have to be adhered to or in some cases not even used. A planned corrective action for that event included revising Station Directive 4.2.1 to be more specific in requirements of use of procedures for performing station activities. That corrective action has been scheduled for completion and should also apply to this event.

There are no Employee Training Qualification System (ETQS) requirements for IAE personnel concerning lockout relays since this system is not safety related and IAE personnel do not normally perform work on these relays. However, there are qualification requirements for this system for Relay personnel. Relay personnel involved in this incident were ETQS qualified.

The loss of offsite power to Unit 1 caused a loss of the ND system on Unit 1. However, Operations personnel implemented Abnormal procedure, Loss of ND system, and started ND pump (EIIS:P) 1B which then automatically received power from the emergency bus powered by Diesel Generator 1B. The ND system was restored to normal service within 6 minutes after the Blackout occurred

when the 1B Busline was restored.

The Unit 1 Blackout also caused a loss of power to VI Compressors A, C, and D which were powered from Unit 1. This loss of VI resulted in a rapid decrease in pressure in the VI header. As a result, the air operated CF regulating valves closed due to low air pressure which caused the reactor to trip on a low-low S/G level signal.

The VI compressor mode selector switches were positioned as follows during the Blackout: A-Off; B-Standby 1; C-Base; D-Running (Base). Although VI Compressor B was selected for Standby 1 mode, it did not start on low VI header pressure during the Blackout. This compressor was powered from Unit 2, so it did not lose power during the Blackout. The Operations person who went to the VI compressors during the Blackout reported that none of the compressors were running when he arrived. Apparently, the start button had not been pressed when Compressor B was placed in Standby 1 mode, thus not activating this mode. Personnel responsible could not be identified.

As NSM has been written and evaluated to add 2 additional 1500 CFM centrifugal air compressors to the VI system. Construction has been scheduled.

There were few anomalies noted during the Unit 2 Reactor Trip. All condenser dump (SB) valves operated properly. However, proper computer indication was not received for valve 2SB-6. A work request was written to investigate this problem. The Unit 2 Events Recorder and Alarm Summary had a time discrepancy of 20 seconds. A work request was submitted to investigate and correct the time. The atmospheric steam dump valves were not needed and did not open. No Pressurizer Power Operated Relief Valves (PORVs) (EIIS:RV) lifted since the relief setpoints were not reached. All other safety systems responded as expected. Control Room personnel responded properly to stabilize Unit 2 from the Reactor Trip and restore offsite power to Unit 1.

A review of past LERs revealed 1 similar event (LER 369/85-34) where a loss of VI resulted in Unit 1 and Unit 2 Reactor Trips. However, this event was due to a rupture of flexible piping on the VI compressors. Therefore this event is not considered recurring.

This event is not Nuclear Plant Reliability Data System (NPRDS) reportable.

CORRECTIVE ACTIONS:

Immediate: 1) Operations personnel implemented the Loss of Electrical Power procedure for the Unit 1 Blackout and Loss of ND System procedure for the subsequent loss of the ND system.

2) Operations personnel started ND Pump 1B.

3) Operations personnel implemented the Reactor Trip procedure for the Unit 2 Reactor Trip.

4) Operations personnel restored offsite power to Unit 1 by re-energizing the 1B Busline.

5) Operations personnel stabilized Unit 2 from the Reactor Trip.

Subsequent: 1) Operations personnel reset and restated the tripped VI compressors.

2) Operations personnel returned the Unit 1 ND system to the normal electrical alignment.

3) IAE and Relay personnel tested the 1B Busline associated lockout relays using the Functional Verification of the "Lockout" Relays and Associated Indicating Lights, Temporary Test procedure which was changed to include specific steps necessary to perform adequate verification of lockout relay modifications.

Planned: 1) Operations will evaluate changing VI compressor power alignments so that 2 VI compressors will normally be aligned to each unit.

2) Duke Design Engineering personnel will review the power supply alignments for VI Compressor D and the 2 proposed additional compressors to assure automatic transfer capability and automatic restart capability during a Blackout.

3) The McGuire Station Manager will communicate the importance of using and not exceeding (or deviating from) the established directions of existing procedures to appropriate station personnel.

SAFETY ANALYSIS:

Blackout

The event was initiated during testing of a modification to the Unit 1 lockout relaying in the generator relaying zone. This caused the 1B Busline to

de-energize while the 1A Busline was already out of service for maintenance. This in turn caused a Unit 1 Blackout and the start of the 1B Diesel Generator.

At the time of the event, the 1A Diesel Generator was out of service for maintenance during the outage and was unavailable. The 1A Busline was also out of service for maintenance work. This condition was within the minimum allowed redundancy under Technical Specification 3.8.1.2. Following the loss of 1B Busline, the 1B Diesel Generator started and loaded. In the event that the Diesel Generator could not be started and loaded, the Operators would have been referred from the Loss of Electrical Power procedure to the Loss of All AC Power procedure. Subsequent Action Step 5 of the procedure refers them to Enclosure 3, which gives instructions for restoring offsite power. Step 6 directs them to Enclosure 4, which gives instructions for energizing the 4160V bus(es) from Unit 2. Offsite power was available to the 230KV switchyard and power was available from Unit 2 throughout this event.

The analysis of the "Loss of Non-emergency Power to the Station Auxiliaries" accident in Section 15.2.6 of the McGuire Final Safety Analysis Report (FSAR) does not cover the initial conditions found on Unit 1 in this event. This FSAR event analyzes a loss of offsite power from full power operation. The equipment available and needed to mitigate this event is different than a loss of power from a cold shutdown condition. As part of the follow-up analysis for INPO Significant Operating Event Report (SOER) 85-4, analysis was done on the effects of loss of the ND system. According to a Duke Power Design Engineering the worst initial conditions for a loss of the ND system would be having the Reactor Coolant (NC) (EIIS:AB) loops partially drained early in the outage, when decay heat load would still be high. With these initial conditions (NC at 100 degrees Fahrenheit, NC depressurized, NC loops drained down to 7 inches above the loop centerline elevation, and 5 days decay time after shutdown, the time to saturation conditions would be 14 minutes following a loss of the ND system, and the time to uncover the core would be 2.5 hours after the vessel (EIIS:VSL) reached saturation. The 14 minutes represents the minimum time for restoring the ND system to prevent the NC system from becoming saturated. If decay heat is lower (because the time after shutdown is greater) or the NC volume is higher, the times will be correspondingly longer.

The Unit 1 ND pump motors (EIIS:MO) are fed directly from Essential Switchgear Groups 1ETA and 1ETB. They are 4160 volt loads, and each ND pump motor requires 400 hp. They are not automatically loaded on to the Diesel Generators in the event of a Blockout. (For a LOCA they are a part of load group 3 which is required to automatically load within 20 seconds.) Thus, in the event of a Blackout from shutdown conditions, prompt operator action is required to restore decay heat removal. The ND pump(s) can be energized once the 4160V buses are energized by closing the breaker(s) onto the

bus(es). This can be done

from a pushbutton in the Control Room or from the Auxiliary Shutdown panel. During this event this was done within the time constraints discussed above.

In this event, offsite power was restored within 6 minutes. Power to the ND system was restored when Operations personnel loaded ND Pump 1B onto Diesel Generator 1B. Normal power to the ND system was restored when offsite power was restored to Unit 1.

If one Busline is lost during normal operations, a Turbine/Generator (EIIS:TG) Runback to approximately 56% turbine load is initiated; a Reactor Trip is not expected to occur. This would have been a much less severe event.

The 1B Diesel Generator started and loaded as required in response to the Blackout. With the Events Recorder being inoperable, it is difficult to tell if the Diesel Generators loaded properly. (The Unit 1 Events Recorder was out of service because of outage related work.) From the information available on the Alarm Typer (EIIS:ALM), it appeared that the loads which were in service for the given plant conditions were loaded properly.

Unit 1 was subcritical at all times during the event.

Reactor Trip

The initiating signal was not available on the Unit 2 Events Recorder to calculate the Reactor Trip Breaker response time. (This has been identified as a follow up item in the Transient Cycle Report.) The Turbine tripped on a Reactor Trip signal. Safety Injection and Emergency AC Power were not required in this event. Main Feedwater isolated on Reactor Trip with low NC system average temperature signal 27 seconds after the Reactor Trip. This response was as expected. Both Motor Driven Auxiliary Feedwater (CA) (EIIS:BA) pumps were actuated because of low-low level in S/G C. The pumps started and delivered flow to the S/Gs within the 60 seconds expected time. The Turbine (EIIS:TRB) Driven CA pump started as designed when the second Steam Generator (S/G) fell below the low-low level setpoint. It delivered flow within one minute of receiving its actuation signal. No Pressurizer PORVs or Code Safety Valves were required to mitigate this event. Maximum Pressurizer (EIIS:PZR) pressure was 2269 psig. Main Steam pressure remained below the setpoints for the S/G PORVs and Code Safety Valves, reaching a maximum post-trip pressure of 1111 psig.

The reactor was shutdown by rod insertion. Residual heat was removed by the

CF and CA systems to the condenser. Adequate core cooling was maintained at all times. The reactor pressure boundary was not challenged. The CA system started and responded properly when needed to remove decay heat.

This event is analyzed as a "Loss of Normal Feedwater Flow" in Section 15.2.7 of the McGuire FSAR. The transient in the FSAR is more severe because it assumes that the steam dump to condenser valves (EIIS:RV) are not available to remove decay heat, and single failure in the CA system is assumed. In addition, this event was less severe than the previous event involving the loss of the Instrument Air system on November 2, 1985, as documented in LER 369/85-34.

There were no personnel injuries, radiation overexposures, or releases of radioactive material as a result of this event.

This event is considered to be of no significance with respect to the health and safety of the public.

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October 29, 1987

U. S. Nuclear Regulatory Commission
Attention: Document Control Bank
Washington, D. C. 20555

Subject: McGuire Nuclear Station
Docket Nos. 50-369 and 50-370
Licensee Event Report 369/87-21

Gentlemen:

Pursuant to 10 CFR 50.73 Sections (a)(1) and (d), attached is Licensee Event Report 369/87-21 concerning the Unit 1 Loss of Power and Unit 2 Reactor Trip that occurred on September 16, 1987. This report is being submitted in accordance with 10 CFR 50.73(a)(2)(iv). This event is considered to be of no

significance with respect to the health and safety of the public.

Very truly yours,

/s/ Hal B. Tucker
Hal. B. Tucker

SEL/139/sbn

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